The X-PRESS

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EC04 0310-25 NASA Photo by Tony Landis

A U.S. Navy E-2C Hawkeye recently arrived for tests in the Dryden Loads Laboratory, where loads equations will be developed to assist the Navy in determining how the aircraft will respond to the added weight of planned modifications.

E-2C Hawkeye

Loads Lab tapped for 7-month Navy job

■ Work represents a new focus on marketing the Center's strengths

By Jay Levine
X-Press Editor

A U.S. Navy E-2C Hawkeye, a carrier-based electronics platform that serves as the eyes and ears of carrier battle groups, arrived at Dryden recently from its base at the Naval Air Warfare Center Aircraft Division at Patuxent River, Md.

The Hawkeye, distinctive with its 24-foot diameter rotating radome, is part of a fleet of aircraft that has been operational for more than 30 years and is about to undergo modifications that will add weight to the aircraft. Navy officials have asked Dryden to help formulate loads equations aimed at determining how the additional weight will affect the aircraft's flight envelope.

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EC04 034-14 NASA Photo by Tony Landis

A Navy C-130 based at the Naval Air Warfare Center Aircraft Division at Patuxent River, Md., landed at Dryden to deliver tools for the upcoming Loads Laboratory work on the E-2C Hawkeye.

UAVs taking center stage

■ Dryden role extends to include other areas of aeronautics research

By Jay Levine
X-Press Editor

People could be flying around like characters in the popular 1960s-era cartoon "The Jetsons" once NASA unlocks technology barriers that will allow commercial enterprise to mass-produce the vehicles introduced in the science fiction of the last century.

Don't expect George, the Jetson family patriarch, and his boy Elroy to pull up to your curb just yet. But it's increasingly central to NASA's aviation vision to focus on identifying technological impediments, developing incremental steps to eliminate those problems and creating solutions through flight experiments.

Uninhabited Air Vehicles, or UAVs, and NASA's role in aeronautics research were the focus of an Oct. 7 seminar at Dryden. Guest speakers at the event, which was organized by Dryden Communications Officer Jenny Baer-Riedhart, included Robert McKinley and Teresa Kline, associate and deputy program manager for strategy, respectively, for the Vehicle Systems Program, within the aeronautics research mission directorate at NASA Headquarters.

A brief video displayed UAVs on which Dryden played a role in maturing technologies. The video also had an animation of a Jetsons-style aircraft rolling out of the garage, wings deploying and taking to the skies.

McKinley and Kline said Dryden will be central to the entire spectrum of NASA's aeronautics research. Every NASA aeronautical project undertaken with the VSP will be geared toward inclusion in an experiment on a testbed, or in an integrated system of technologies that could be part of a new experimental vehicle.

The vehicle integration, strategy and technology assessment team directed by McKinley and Kline within the VSP office contains six vehicle sectors through which aeronautics goals will be

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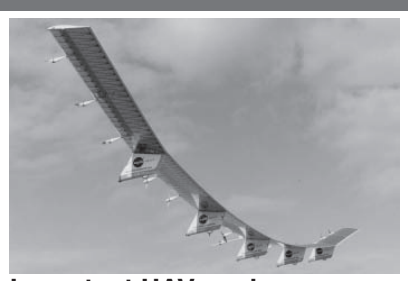


Enterprise gets its due

Researched at Dryden, prototype refurbished for display

By Peter Golkin
Office of Communications
National Air and Space Museum,
Smithsonian Institution

Visitors to the Smithsonian Institution's National Air and Space Museum Steven F. Udvar-Hazy Center will get their first chance to explore the hangar's remarkable holdings beginning Nov. 1.

The collection is highlighted by Space Shuttle Prototype Enterprise, a research aircraft that validated aerodynamics and flight controls systems for the Space Shuttle fleet during flights at Dryden from the back of a modified NASA 747.

Although the Udvar-Hazy (pronounced OOD-var HAH-zee) Center in Chantilly, Va., opened to much acclaim last December, the 53,000-square-foot James S. McDonnell Space Hangar was inaccessible while its star attraction, Enterprise, was being refurbished. With that project now complete, hundreds of other artifacts have been added to the exhibition hall, from a 69-foot, floor-to-ceiling Redstone missile to tiny "Anita," a spider carried on Skylab for web formation experiments.

The hangar and its holdings illustrate the scope of space exploration history as organized around four main themes: rocketry and missiles, human spaceflight, application satellites and space science.

"The Smithsonian's National Air and Space Museum has always been known as the home of the icons of flight. The James S. McDonnell Space Hangar at the Udvar-Hazy Center gives us the chance to share much more of our vast collection as we present the story of space exploration in richer detail," said museum director Gen. J.R. "Jack" Dailey.

SI2004-56168h Photo courtesy the Smithsonian Institution

The refurbished Space Shuttle Prototype Enterprise goes on display Nov. 1.

A total of 113 large space artifacts are housed in the hangar. The biggest and heaviest, including Enterprise, an instrument ring segment of a Saturn V rocket that was never built and a Space

See Enterprise, page 7

The thrill of the drill

Emergency preparedness takes practice

By Sarah Merlin
X-Press Assistant Editor

When Dryden public affairs specialist Art Nash went to the movies recently, he got a taste firsthand of the old adage about what happens when somebody shouts "Fire!" in a crowded theater.

"The fire alarm went off," said Nash, one of more than 100 Dryden volunteers who act as fire wardens during their workday at the Center. "And right away, my wife and I and other people in the theater we were in started leaving.

"The first thing that happened was, some of us went toward the exits, and some went into the hallway, which is what the theater staff told us to do. Me, I've been trained to head for the exits. But before I could get to the exit, the man in front of me stopped and wanted to talk."

Once Nash and his wife finally got outside, he said, he saw that tickets went right on being sold, moviegoers went right on piling into the lobby, concessionaires went right on selling popcorn. Theater staff didn't know how to turn the alarm off. Another patron stopped to offer conjecture to a manager about what might have caused the alarm to go off.

"It was pretty clear to me pretty quick," Nash said, "that nobody there – not the theater staff or the public – knew what was going on or had the slightest idea what they should do."

All of this on a busy holiday in a 20-plus-screen movie theater full of people. Fortunately, there was no fire.

Nash's experience illustrates why Dryden safety officials place such a premium on disaster preparedness drills. Through periodic fire and emergency exercises, employees are given every opportunity to familiarize themselves with procedures that could mean the difference between life and death.

Drills are most useful, according to Susan Ligon, facilities operations

See Drill, page 8

EC04 0306-13 NASA Photo by Tom Tschida

Cafeteria closes, will reopen in the spring

Dryden cafeteria workers were given a big thank you and a temporary sendoff Oct. 22 after all their hard work serving up meals to Dryden employees. From left are Lucy Halvis, Shanta McClinton, Manager Venus Long, Cassandra Johnson, Susan Bixby, Chona Azaeta and Maria Colburn.

The workers will staff a food outlet at Edwards South Base until their return in the spring, when renovations are complete. Information on the interim Meals on Wheels program is available on the Dryden Intranet.

News at NASA

Return to flight set for May 2005

After extensive deliberation, NASA is planning the return to flight Space Shuttle mission, designated STS-114, for a launch window that opens in May 2005. The Space Flight Leadership Council endorsed the recommendation for the late spring window, which spans the period between May 12 and June 3, 2005.

A launch-planning window that opened in March 2005 was scuttled after a series of hurricanes impacted operations at multiple facilities. Kennedy Space Center, Marshall Space Flight Center, Stennis Space Center and Michoud Assembly Facility all experienced shutdowns in preparation for one or more of the four hurricanes in August and September, resulting in delays on return to flight work.
http://www.nasa.gov/news/highlights/returntoflight.html

'Why We Explore' series continues

NASA's online history series "Why We Explore" continues on the NASA Web portal.

The online essay series premiered Oct. 1. As the Agency prepares to journey to the moon, Mars and beyond, NASA Chief Historian Steven J. Dick takes a look at humanity's continuing desire to seek out new worlds.

In the third installment of the series, Dick discusses "Consequences of Exploration: Learning from History."

"Why We Explore," including other news and multimedia features about the vision for space exploration, is available on the Internet at http://www.nasa.gov/newvision. A multimedia feature about NASA's history, produced in 2003 to commemorate the Agency's 45th anniversary, may be viewed at http://www.nasa.gov/externalflash/NASA45th. More information about the history of NASA is available on the NASA History Office homepage, http://history.nasa.gov.
http://www.nasa.gov/home/hqnews/2004/oct/HQ_m04173_history_series.html

NASA technology featured at event

NASA's cutting-edge research and technology will be showcased Nov. 6-12 at the International Conference of High Performance Computing, Networking and Storage (SC2004) in Pittsburgh's David L. Lawrence Convention Center.

"Bridging Communities" is the theme of SC2004. Now in its 16th year, the conference brings together representatives from many technical communities to exchange ideas, share recent successes and plan the future of supercomputing.
http://www.nasa.gov/home/hqnews/2004/nov/HQ_04364_super_computing.html

EC04 0307-02 NASA Photo by Tom Tschida

Disco Inferno chili by the chefs in Code S took home the People's Choice award at the annual Dryden chili cook-off and bake sale. Above from left, serving up the hot stuff are Maria Caballero, Debby Parham, Linda Carson and an unidentified helper. Code S also reigned in the costume contest, netting the Best Group Costume award as the Village People, below right.

FRIGHTENING FUN

Dryden gets into the SPIRIT of Halloween

Dryden employees scared up $807 Oct. 22 at the Center's annual bake sale and chili cookoff. In keeping with tradition, funds raised will be used to purchase food for the annual holiday food drive to assist those in the Dryden community who could use a helping hand.

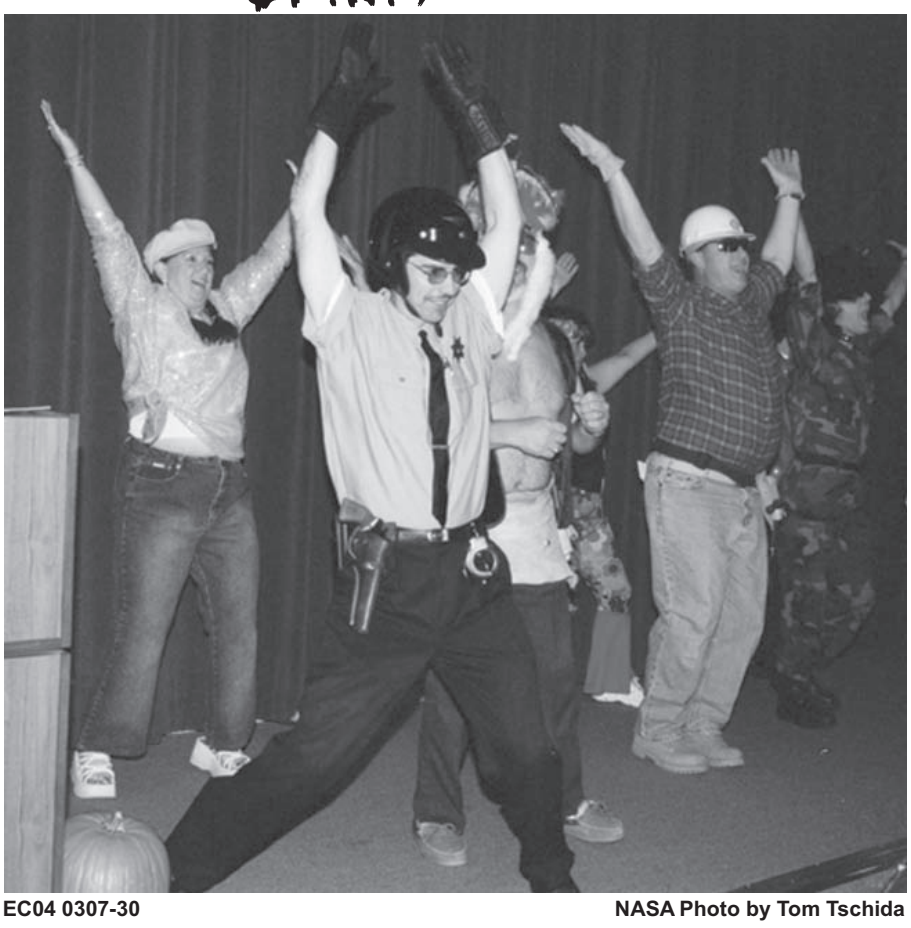
The cash total beats last year's by $88. In addition to funds raised, donations of canned goods also will go toward the holiday drive.

Chili contest participants mixed up their best brew and 10 entrants competed for honors.

Chili contest winners were chosen by a panel of judges for one award and by chili consumers for the other. The People's Choice award went to "Disco Inferno Chili" by the chefs in Code S. Judge's Choice honors went to "I Brewed it Last Night Chili" by Lydia Dorfman.

A collection of monsters, sprites, princesses and pop icons made judges' decisions tough in the costume competition. Best Group Costume honors went to the safety office's Village People, while the Most Original costume award went to Peter Merlin of the History office, who dressed as a Russian cosmonaut.

Code H and Blakely Lord sponsored the bake sale and Lesa Brown coordinated the costume contest.



EC04 0307-30 NASA Photo by Tom Tschida

EC04 0307-30 NASA Photo by Tom Tschida

Associate Director for Management Gwen Young greets Comrade Peter Merlin, who took home Most Original costume honors.

EC04 0307-09 NASA Photo by Tom Tschida

Associate Director for Management Gwen Young, left, announced the winners of the costume and chili contest at the Oct. 22 event. Above, she takes time out to exchange pleasantries with the Wolfman and a firefighter.

One NASA workshop set for Dec. 3

Led by Rear Adm. Craig E. Steidle, USN (Ret.), associate administrator for the exploration systems mission directorate, the One NASA team will present another round of leader-led workshops at each of the NASA centers. Dryden's workshop will be held Dec. 3. The workshops are part of a continuing effort to provide all employees with a better understanding of the Agency's exploration vision and each center's role in the initiative.

Lakebed Legacies

Oct. 21, 1947 – First X-1 flight by a NACA pilot in X-1-2 (46-063). Herbert H. Hoover made a successful glide flight.

Oct. 23, 1951 – Last flight of X-1-2 (46-063). Airplane was subsequently rebuilt as X-1E.

Oct. 20, 1952 – Official first flight of X-3 (49-2892).

Oct. 8, 1954 – First powered flight of X-1B (48-1385) by Maj. Arthur "Kit" Murray.

Oct. 25, 1955 – Neil A. Armstrong piloted the last flight of Bell X-5 (50-1838).

Oct. 11, 1961 – First X-15 flight to exceed 200,000 feet. Maj. Robert M. White piloted X-15-2 (56-6671) to 217,000 feet.

Oct. 8, 1962 – William G. "Gus" Briegleb of Sailplane Corporation of America signed contract NAS4-253 to build a plywood shell for the M2-F1 lifting body research vehicle for $8,000 at El Mirage, Calif.

Oct. 6, 1966 – First X-15 flight for Maj. Michael Adams. He made an emergency landing at Cuddeback Lake, Calif., in X-15-1 (56-6670).

Oct. 3, 1967 – Maj. William J. "Pete" Knight flew the X-15A-2 (56-6671) to an unofficial world speed record of Mach 6.7 (4,520 mph).

Oct. 23, 1968 – Maj. Jerauld Gentry piloted the first powered flight of the HL-10 lifting body research aircraft.

Oct. 24, 1968 – William H. Dana piloted the 199th and final X-15 flight in X-15-1 (56-6670). The airplane was subsequently retired to the Smithsonian Institution's National Air and Space Museum in Washington, D.C., for permanent display.

Oct. 9, 1999 – The SR-71A (61-7980/NASA 844) made its final flight, a demonstration at the Edwards Air Force Base Open House. Rogers Smith and Robert Meyer flew the aircraft to Mach 3.21 and 80,100 feet. The aircraft was subsequently stored at Dryden and eventually placed on static display. No other SR-71 ever flew again.

The Promise of ERAST

EC97 44102-2

By Jay Levine
X-Press Editor

A key anniversary in the development of uninhabited air vehicles quietly passed this fall. It marked 10 years since an agreement was signed that resulted in maturation of technologies, science instruments and sensors required for UAV missions.

The foundation for the Environmental Research and Sensor Technology program was laid Sept. 14, 1994, when the final signature dried on what was called a Joint Sponsored Research Agreement. A year had passed between the first meeting between NASA and four potential ERAST partners and the signing of the JSRA, then a new and unique type of funding mechanism tailored for use in the ERAST program. Designed to facilitate collaboration between government agencies and the private sector, the JSRA differed markedly from conventional government procurement agreements.

Program officials have said the Dryden-based ERAST program might have failed without the JSRA, which was first researched as a new contracting option in the 1980s at NASA's Ames Research Center, Moffett Field, Calif. Ames officials had previously convinced NASA Headquarters to permit use of a JSRA in three smaller projects, but the ERAST program was the first large-scale initiative to make use of it.

Ames attorney Jack Glazer began in 1988 to examine the possibility of invoking the Other Transactions Authority clause in the Space Act of 1958 for application to collaborative projects. Seeing the complexity of the undertaking, Glazer advocated for creation of a non-profit company, AmTech, to document JSRA legal and policy issues and form prototype projects. Then to encourage officials at NASA Headquarters to consider the JSRA as a potential contracting option, AmTech recruited Paul Dembling, NASA's first General Counsel and author of the Space Act, to its board of directors.

The idea of convincing NASA Headquarters of the JSRA's worth was aimed at streamlining the process of forging agreements between industry and government. Even intellectual property rights – often a deal-breaker in government research agreements – would be on the table, a dramatic departure from standard government contract negotiations. In a JSRA such as the one governing the ERAST program, intellectual property rights address ownership of information garnered during the course of research.

Karen Robbins, who as a law student researched JSRA components for NASA's legal department and later was a founding member of AmTech, was key to development of Dryden's JSRA for the ERAST program. It was fitting that she work on the first of the large projects to make use of the JSRA, having essentially "written the book" on JSRAs between 1988 and 1994. Robbins' development of the JSRA model and handbook led to acceptance of the JSRA by NASA as a viable legal agreement. Following three successful smaller efforts at Ames, Robbins was ready to apply what she'd developed to something as large as the ERAST program.

As a means of enticing private industry into collaborating on the ERAST program, then, Dryden representatives began considering a JSRA as an alternative to agreements traditionally used by NASA.

In some private-sector circles, NASA – and government agreements in general – had earned a reputation for creating what many viewed as unnecessarily complicated working relationships; ERAST planners recognized the potential liability such a reputation posed in attracting business partners.

Rich Christiansen, then NASA Headquarters acting division director for high-performance aircraft and flight projects (and later Dryden associate director for planning, from 2000 to 2003) said it was becoming clear that the JSRA was the appropriate funding mechanism for the ERAST program. Consultations with then-ERAST Project Manager Jenny Baer-Riedhart confirmed Christiansen's belief that use of the JSRA offered the best chance for success. Lacking confidence that the program's goals could be met through traditional agreements, Christiansen decided to champion the JSRA for use in the ERAST program.

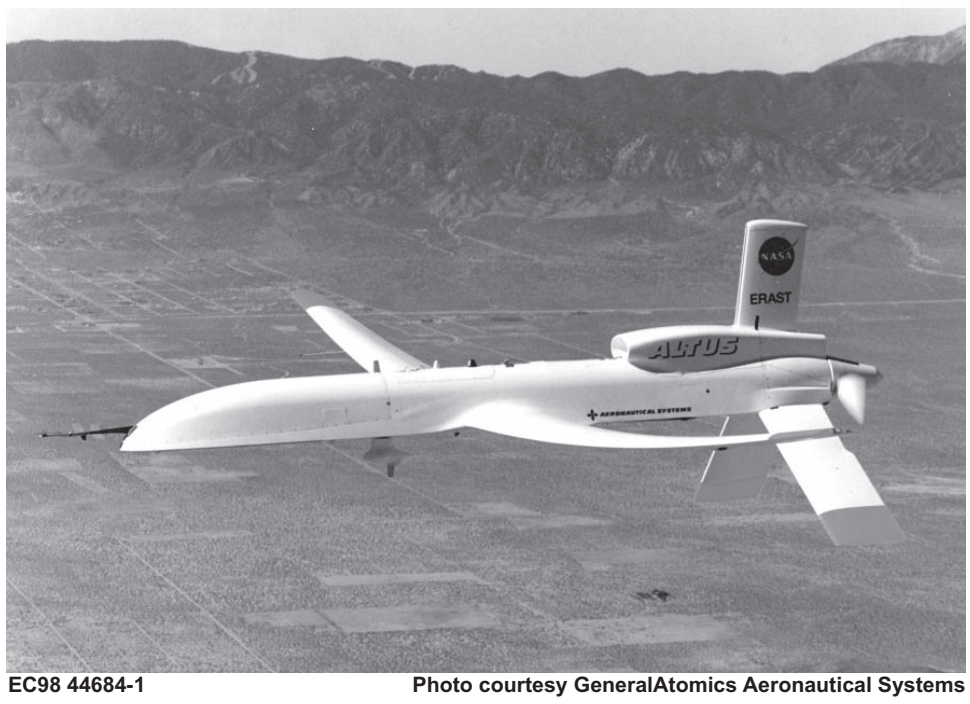
"Several individuals and companies said they all could accomplish the task of collecting science data at 100,000 feet to support high-speed research," Christiansen recalled in a recent interview. "My confidence in their ability to gain that data was low. So was my confidence that I could write an RFP (request for proposal) that would encompass all of our requirements. There was not a lot known about flying at altitudes that ERAST research aircraft would be designed to conquer."

So the JRSA, initially intended to encourage small projects between government and academia, now was seen as a tool for leveraging the best and brightest of a fledgling industry.

ERAST program goals included putting together solid engineering data to define flight-envelope boundaries and meet the challenges of high-altitude, long-endurance flight, and development of the sensors and tools required to meet the needs of the wider science community. Participation by forward-thinking engineers in the public and private sectors would be required to attain those goals, and ERAST planners had created a contracting environment they felt would maximize the ambitious program's chances for success.

An unlikely alliance

Federal publications advertised a 1993 kickoff meeting for private companies interested in participating in the new ERAST program. Larger companies quickly dismissed the program concepts, and none attended. But a handful of fledgling companies saw potential in obtaining a piece of some new research work, and also in



EC98 44684-1 Photo courtesy GeneralAtomics Aeronautical Systems

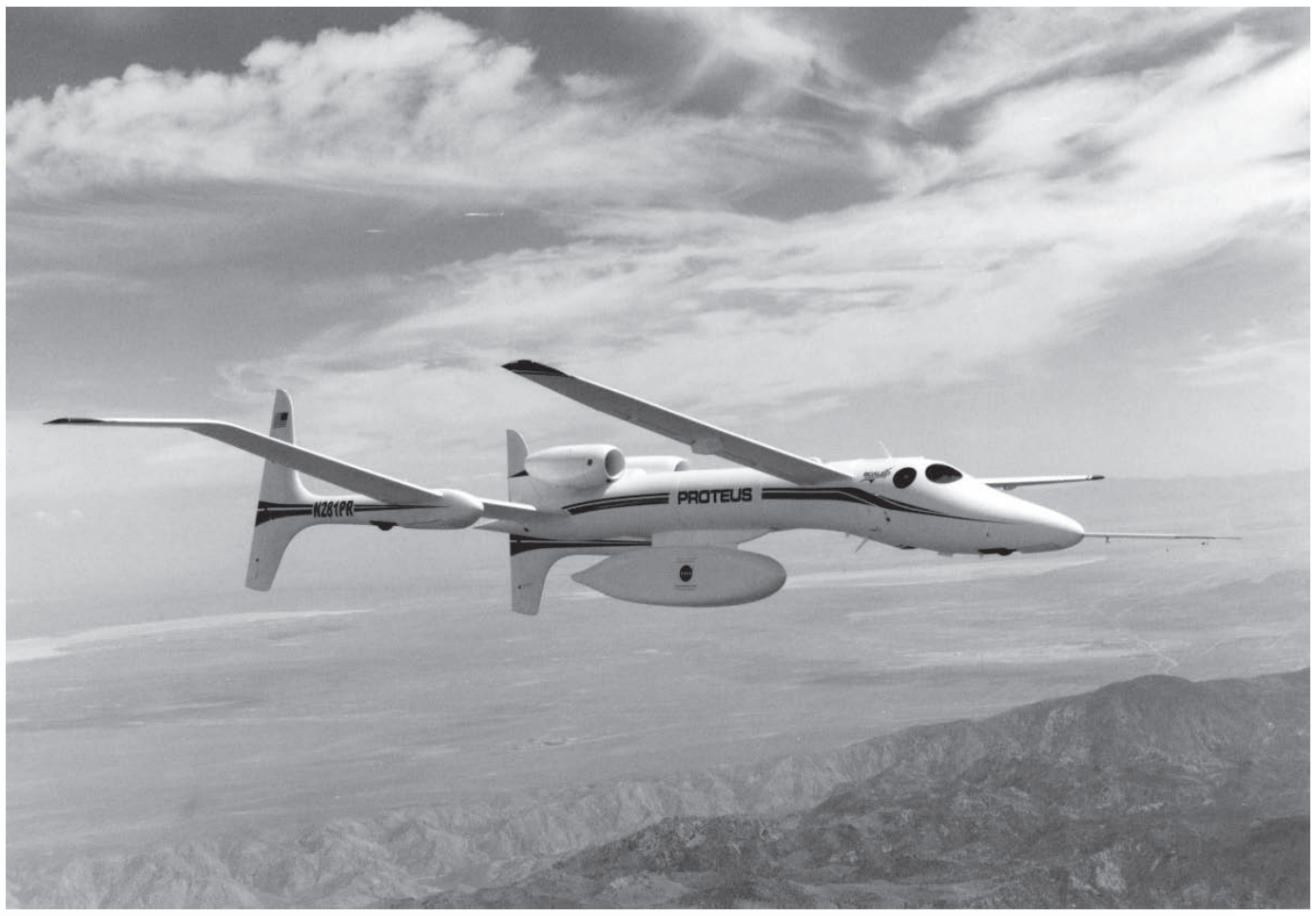
The remotely piloted Altus II, built by General Atomics Aeronautical Systems, flies over the Antelope Valley. It was developed in the ERAST program to validate such technologies as the dual turbo-charged engine. It flew to more than 57,000 feet and for more than four hours.

EC99 451-85-1 NASAPhoto by Tom Tschida

The piston engine, propellor-powered aircraft Perseus was designed and built by Aurora Flight Systems, Manassas, Va. As part of the ERAST program, the aircraft achieved an altutude of 60,200 feet on June 27, 1998.

NASA Photo

Above, the Scaled Composites Demonstrator 2, or D-2, takes to the skies over Mojave. The D-2 could fly piloted or remotely piloted and in 1996 was linked to NASA's Tracking and Data Relay Satellite System to successfully demonstrate over-the-horizon communication capabilities between the aircraft and ground stations 2,000 miles apart.



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NASA Photo by Tony Landis

Below, the Helios Prototype reaches a record altitude of 96,863 feet on an Aug. 13, 2001, flight from the Pacific Missile Research Facility in Kawaui, Hawaii.

Above, Scaled Composite's Proteus aircraft flies over the skies of the Antelope Valley.

At right, Burt Rutan, Scaled Composites president and then-chief executive officer and Ray Morgan, right, then-AeroVironment vice president and director of the company's Design and Development Center, Simi Valley, Calif., shake hands at an Environmental Research Aircraft and Sensor Technology open house at Dryden Oct. 13, 1999. The handshake symbolizes the atmosphere of cooperation created in the ERAST program.

EC99 4520520

NASA Photo by Tony Landis

EC01 247-15

NASA Photo by Nick Galante

obtaining new funding. They were less enthusiastic, however, about sharing information with competitors and placing ideas on the table about new propulsion and power sources and conceptually different airframes.

"Initially, we were very skeptical. It was too good to be true," recalled Ray Morgan, then head of AeroVironment's Simi Valley, Calif., facility. "A lot of members had had experience under NASA contracting, and almost felt like they were being punished for something they did as a little boy or girl. Even rights to data the company had gathered were hard to get. Now we were being encouraged to commercialize? What's the catch?"

Four companies forged the ERAST foundation: AeroVironment, headquartered in Monrovia, Calif.; Aurora Flight Sciences, Manassas, Va.; General Atomics Aeronautical Systems, San Diego; and Scaled Composites, Mojave, Calif. Company representatives literally took four different corners of the room during the first meeting of ERAST hopefuls, and weren't particularly chatty – hardly an ideal way to begin a program.

The ERAST JRSA – in its original form, a six-page document – grew to more than 80 pages during the next year as each company's lawyers requested changes. But as required signatures were given, participants could begin work. The next step involved representatives of each company forming a single group called the Alliance Council, to provide project oversight. Alliance members helped determine the type of technologies that would be pursued in the interest of benefit to all parties and the UAV industry, rather than to any single entity.

Each company made contributions to the project work through some combination of cash and services, but also relied in part on government funds allocated through the terms of the JSRA. In the project's first year, 1994, the federal money was split equally four ways, with the council deciding that fund allocation would be permitted to vary in the next funding cycle.

A key component to the JSRA was that it permitted in-kind contributions, which allowed small businesses to provide goods and services to cover their contribution – an important work-around to the usual 50-50 price-sharing agreements typical of traditional government contracts. Such costs were traditionally much too high for fledgling aerospace companies pursuing untried UAV technology. That was certainly the case with AeroVironment, a company that had enjoyed success with its UAV work but did not necessarily have the financial clout to be part of any agreement requiring substantial up-front cash.

Morgan summed up conditions in the UAV development community at the time this way: "The history of UAV's had been businesses started in a garage, with each company learning the same lessons the hard way."

Anyone familiar with government contracting and the complications of dealing with the adversarial nature of the relationship, including intellectual property disputes, knows why the skeptics were many, he said.

"(ERAST) was the best deal ever for AeroVironment," Morgan said, an accurate assessment in light of the fact that with its contributions, the company revolutionized solar aircraft during the program's nine-year run.

The crucible

If disagreements existed among the ERAST partners it wasn't apparent to the outside world, as program milestones were met regularly.

Then, in 1995, came a true test of the JSRA. While the four companies split the budget evenly in 1994, the time came for Alliance members to decide how to disburse dollars for the second budget year.

See ERAST, page 7

Dryden returns YO-3A to Ames

Dryden technicians have refurbished the YO-3A aircraft for a series of research flights at Ames Research Center, Moffett Field, Calif.

Hoses, tires, and belts were replaced and the aircraft returned to flying status in preparation for the craft's return to Ames.

Dryden acquired the aircraft in December 1997 from Ames. Engineers there had originally obtained the aircraft from an airframe and powerplant mechanics school and modified it for use as an acoustical flight research aircraft, to record noise levels of aircraft in flight.

That is similar to the type of work it will be used for when it is returned to Ames. The YO-3A's wingtip and tail-mounted microphones make it ideal for acoustic research, which in the upcoming flights will mean acoustical measurements of helicopters and rotocraft.

Past missions undertaken with the aircraft have included sonic boom measurements of a NASA SR-71 and various helicopter and tiltrotor noise measurements.

Lockheed engineers developed the YO-3A from a Schweizer SG2-32 sailplane during the 1960s as an observation plane for use in the Vietnam War. The aircraft's ultra-quiet design and large bubble canopy allowed pilots to move stealthily and at low altitudes over enemy territory to observe troop locations and movements, particularly at night.

It's estimated just 13 to 15 of the aircraft were built. The model Dryden is returning to Ames saw service in Vietnam. In the 1970s, the FBI owned and operated two of the YO-3As.

EC04 0310-25 NASA Photo by Tony Landis

Pilots Dick Ewers, front seat, and Ed Lewis fly the YO-3A, which will be returned to Ames in November for acoustical research flights with helicopters and rotocraft.

Jetsons ... from page 1

categorized, including autonomous or personal air vehicles, a major effort in UAVs and related work; supersonic aircraft; subsonic transports; rotocraft and runway-independent aircraft.

As the assessment team's UAV sector manager, Dryden's Larry Camacho has the critical task of integrating all NASA's UAV technology development work, leading to UAV systems integration and flight demonstrations at Dryden.

In addition to the six vehicle sectors, the VSP also breaks work on the technologies of tomorrow down into seven projects (referred to as Level 2 projects): quiet aircraft technology, ultra-efficient engine technology, low emissions alternative power, autonomous robust avionics, efficient aerodynamic shapes and integration, flight and system demonstration, vehicle integration, strategy and integrated tailored aerostructures.

An outline illustrating how research goals will be realized was reflected in long-term strategy formulated and assembled into what McKinley called a Goals, Objectives and Technical Challenges and Approach (GOTChA) chart. The chart displayed boxes that moved from one project area to another in step-by-step fashion, showing relationships with other Agency goals and objectives. As it flows to the bottom of the page, McKinley explained, leading to a flight experiment, the chart allows officials to show at a glance what the available VSP funding will achieve.

For example, McKinley indicated, using the chart as a guide, a goal for high-altitude, long-endurance remotely operated aircraft research is autonomous mission operations. A corresponding objective is full autonomy during emergencies. The inherent technical challenge is developing long-endurance unaided autonomous operations and navigation, and the approach is through development of lightweight, miniature, robust integrated avionics and sensors.

The culmination of the goal is a successful high-altitude, long-endurance mission demonstration of the integrated technologies of the Suborbital Long Endurance Observer, or SOLEO, platform by the fall of 2009, if incremental steps are funded. Key milestones also are identified, including an upcoming Pathfinder-Plus flight to validate aerostructural-modeling tools to reduce risks and increase chances of mission success.

The approach spelled out in the GOTChA charts represents a changing role for Dryden. Known for integration and flight research prowess, the Center is tapped in the new Agency structure to seek out technologies developed at various NASA centers and integrate them into research systems. Conversely, engineers working at other centers on flight research objectives will be required to connect with a future flight research project or have a plan to integrate with technologies leading to a long-term goal. While NASA won't build vehicles per se in each of the vehicle sectors, McKinley explained, putting together sets of capabilities to resolve technology barriers is the new aeronautics program focus.

David McBride and Eddie Zavala, manager and deputy manager of the flight and systems demonstration project, respectively, will be on the lookout for emerging technologies at all NASA centers and will look for ways those technologies can "graduate" through the crucible of flight research. That is the culmination of any research project on the GOTChA charts – flight research, or integration into a larger set of technologies for experimental aircraft.

Research does not always lead to breakthroughs, McKinley acknowledged, but the concept being promoted by NASA Administrator Sean O'Keefe is one of developing technologies needed by the private sector and maturing those technologies to where they can be transitioned to NASA customers and private-sector users, eventually permitting the American taxpayer to reap the benefits of federally funded research.

Dryden's current focus is on the UAV aspect of the new aeronautics research mission directorate plans, since UAV business at Dryden is sharply rising. It will increase from 24 percent of the workload in fiscal year 2004 to more than double that in fiscal year 2005, and is projected to grow to as much as 60 percent of the Center's business by the end of the decade. During the seminar, Randy Albertson provided an overview of these potential new UAV projects and partnerships pursued within the Dryden Program Planning Office.

A panel discussion also included a brief examination of key programs, including a presentation by Dryden's Mark Dickerson, who described the current effort to incorporate high-altitude, long-endurance aircraft into the national airspace. John Del Frate spoke on the development of HALE platforms, including SOLEO and the Global Observer, and Gary Martin expounded on the work of the Joint Unmanned Combat Aircraft System project.

Other speakers included Frank Cutler, detailing the Earth science capability demonstration projects, and John Carter, representing the Autonomous Robust Avionics Project, or AuRA. Dryden UAV chief technologist Chris Nagy discussed potential UAV mission opportunities for high-altitude, long-endurance aircraft. Potential applications include investigating and monitoring hurricanes, volcanoes and weather; Antarctic research; coastal patrol services for the Department of Homeland Security; land management; fire fighting and wildlife census.

Incorporating high-altitude, long-endurance aircraft in the national airspace is a key area of the Center's UAV work. In a collaborative effort with industry, this Dryden-led initiative, now under way, will formulate recommendations to the Federal Aviation Administration for requirements governing high-altitude, long-endurance aircraft and rules that will one day permit such UAVs to fly routinely alongside traditional piloted aircraft.

As part of the technology demonstration efforts, Dryden seeks access to a Global Hawk reconnaissance UAV and an advanced UAV testbed platform such as a Predator B. Acquisition of a Global Hawk or a Predator B would be in addition to a current lease on the shorter-range Altair UAV and lease possibilities for the Scaled Composites-built Proteus. The goal is for Dryden to maintain a stable of UAV aircraft that will enable the defining and redefining this new aviation frontier.

Key partnerships among NASA, industry, academia and other government agencies will seek to guide UAV technology for Earth science uses and for other applications in the far reaches of space. Development of technologies to fuel those concepts will require researchers to travel many of the same paths, and "Dryden has a place in both of these areas," said Camacho, who also is the UAV national task force process team leader.

In his role with the national task force, Camacho heads an effort to develop a comprehensive plan, including best practices, to benefit the infant UAV industry. That work will combine various UAV elements into a national civil UAV assessment.

UAVs are not new to Dryden, where UAV research has been ongoing for more than 30 years. The Environmental Research and Sensor Technology program ended last spring after nine years of pushing the limits of UAV technology while meeting mission goals and setting altitude records. The ERAST program provided a jump-start to development of high-altitude, long-endurance remotely operated aircraft.

"ERAST is still paying dividends," said Camacho, who said opportunity to continue that groundbreaking work exists. He specified a need for continuing development of sensors and other instrumentation, and providing those to scientists.

Whatever the future of aviation research looks like, one thing is clear: UAVs – and Dryden – will be a part of it.

ERAST ... from page 5

"Our plan was to fly to the stratosphere in 1995," Morgan said. "The cost of the (solar) arrays was more than expected and we ran out of money. We flew to 100 feet in August for a checkout flight and then that was going to be it (with funds available under the 1994 budget). Two other companies – Scaled Composites and General Atomics – put the money they didn't use (in the first year of the contract) back into the Alliance account for us to use and because they gave us that money, we reached 50,000 feet with Pathfinder in September. Solar Challenger (another AeroVironment project) had the previous record high for a solar aircraft, at 14,500 feet. Without the support of our former competitors, we would have been dead in the water."

As acknowledgement for its partners' sacrifices, AeroVironment developed project data memos and white papers and circulated flight test and other reports to Alliance members and NASA. The ERAST program's promise of partnership and resources had been realized.

But the potential for budget squabbles – thankfully unrealized – wasn't the last impediment AeroVironment would encounter.

After the 50,000-foot record flight, company officials were invited to bring Pathfinder to the Edwards Air Force Base Air Show and Open House. Officials on both sides agreed to the proposal, and the aircraft was exhibited alongside the F-117 and the B-2.

Following the close of the air show, Pathfinder remained in the hangar until after the military aircraft were removed, as had been agreed to in exhibit arrangements. Hangar doors were opened, however, in 30-knot winds, causing the lightweight Pathfinder to take a short but unintended flight into the pointed nose of the F-117, severely damaging the UAV.

NASA stepped forward with funding for the extensive repairs. Pathfinder's structure was reinforced, improved solar cells were added and in 1997, the aircraft resumed sailing into altitudes previously unknown to solar-powered craft, this time up to 70,000 feet. And because more efficient solar cells replaced those destroyed in the hangar accident, the upgraded model, dubbed Pathfinder-Plus, later broke its own record again, achieving 80,000 feet in 1998.

AeroVironment's Helios Prototype, a Pathfinder derivative, later set the current altitude record of 96,800 feet in level flight Aug. 13, 2001 – higher than any other non-rocket powered aircraft.

EC96 43765-8 NASA Photo

Technicians move a 20-foot section of the Pathfinder during assembly of the aircraft at Dryden in 1996.

Schmooze or lose

Moving Alliance members from focusing on potential gains for their individual businesses to contributing to larger project goals took work. Finding common challenges the companies could tackle without disclosing proprietary information is what Baer-Riedhart sought to do.

"Our secret was open communication between companies to discuss very real issues. In the room there were heated discussions, but we walked out as team. It was key to getting trust and working to understand where others were coming from," she said.

ERAST proved the viability of a commercial UAV industry. Its successes weren't just platforms, sensors and equipment, but identifying major barriers and finding ways to spin the technology to other uses, such as development of better solar cells for residential and commercial uses of the sun's power.

"I would say it was extremely important – not just the technology itself, but to looking at UAVs for non-military purposes and helping mature technologies that would enable industry to begin developing a commercial UAV market," Baer-Riedhart said.

"There still is a long way to go because it's difficult to fly in the national airspace, which also is an issue for military UAVs. NASA non-military UAV work took a tremendous step forward in that, while (reconnaissance aircraft) Global Hawk and Predator proved UAVs' value from the military side," she said.

The ERAST program succeeded in maturing important technologies and allowed scientists to begin posing key questions necessary for development of future UAV commercial applications, she added.

"We laid the foundation by identifying the type of technologies that needed to be developed for these kind of vehicles. Another key was developing what in the line of a, quote, 'better, faster, cheaper' environment you can do and certain fundamental engineering that needs to be done to minimize risk. For instance, in the early days we had to develop (aircraft concepts) without high-fidelity simulation and (instead) use the flight environment of a wind tunnel. We had to do a lot of flights for ERAST and we knew not all of them would be successful."

JSRA – critical then, valuable today

Technologies required for development of UAVs capable of taking on the "dull, dirty and dangerous" missions began with the ERAST program. Now, the work not only continues but is also emerging as a significant portion of Dryden's business and budget.

The ERAST program and advantages introduced through use of the JSRA were key to development of the AeroVironment family of solar vehicles, including Pathfinder, Pathfinder-Plus, Centurion and the Helios Prototype. Under the auspices of the ERAST program, Scaled Composites saw funding for its Demonstrator 2 and for its Proteus mission requirements. Aurora Flight Systems reaped development dollars for its Perseus B. General Atomics, too, came out ahead with funding for Altus II, a precursor to Predator B and its variant, Altair. Dryden currently has a lease for using an Altair for science missions.

Jeff Bauer, a former ERAST program manager, heads an effort currently under way at Dryden to assist the Federal Aviation Administration with research aimed at incorporating high-altitude, long-endurance remotely operated aircraft into national airspace.

"It's hard for me to imagine a government or a country getting the products we developed though ERAST any other way (but through the use of the JSRA). It was an efficient tool for optimizing contributions from the government and private sector. The collaborative and cooperative nature of the project was key to our success," Bauer said.

And the JSRA also is a linchpin of Bauer's latest work with the FAA.

"I'm not sure we could do it if not for the JSRA. (In a traditional agreement), we generally rely on a set of requirements in order for a contract to be issued. But with a JSRA, we can first form the minimum requirements so that eventually we can issue a traditional contract for goods and services we'll need."

In the case of the FAA project, "We want vehicles in the national airspace, but we're not sure yet what the ground rules should be. That's what we're working to determine with industry through this effort. I don't see how a traditional (contract) approach could work with multiple companies and government agencies."

Enterprise ... from page 2

Shuttle main engine, are displayed at ground level. An array of cruise missiles, satellites and space telescopes hangs from above.

The hangar features two elevated overlooks that allow visitors to study suspended artifacts at and above ground level.

More than 500 smaller artifacts are exhibited in customized cases throughout the hangar, including advanced spacesuit prototypes, research crystals formed in orbit, sounding-rocket payloads, space-themed toys from the 1950s and 1960s and even borscht in tubes, prepared for Soviet cosmonauts.

The oldest artifact, the Ritchey Grinding Machine, dates to the 1890s, when it was used to craft a 60-inch mirror for a Wisconsin observatory telescope. The newest artifact is an engineering model created by U.S. Naval Academy midshipmen as they developed, for a class project, the PCSat communications satellite launched in 2001 and still in orbit.

Many of the objects now in the space hangar had been in storage for decades. Some were previewed during recent months in the Udvar-Hazy Center's aviation hangar.

The museum's unparalleled space collection is built on an agreement that gives the Smithsonian first option to acquire any equipment used and then retired by NASA. It includes every retired American spacecraft that flew humans and returned safely to Earth, every spacesuit used to walk on the moon and backups or engineering models of nearly every major American satellite or probe.

The McDonnell Space Hangar is named for aerospace pioneer James S. McDonnell, whose company built many pioneering aircraft and both the Mercury and Gemini spacecraft, flown by the first American astronauts.

Since opening, the Udvar-Hazy Center has attracted more than 1.5 million visitors, making it the most popular museum site in Virginia.

The main National Air and Space Museum building is located on the National Mall in Washington, D.C.

EC04 0310-11 NASA Photo by Carla Thomas

Above is a unique view of the E-2C Hawkeye, which will be at Dryden through June.

EC04 0310-7 NASA Photo by Carla Thomas

The E-2C Hawkeye arrives at Dryden for a series of tests in the Loads Lab.

Hawkeye ... from page 1

A C-130 arrived in advance of the Hawkeye to deliver tools and aircraft support hardware such as aircraft jacks, necessary for the Dryden Loads Laboratory work, which will take until next summer to complete.

A Navy crew will need two to three weeks to prepare the aircraft in Dryden's Research Aircraft Integration Facility, removing engines and purging fuel tanks. As many as eight Navy representatives will be at the Center during the Hawkeye tests.

Essentially, the test series will apply force, or loads, on the aircraft to develop loads equations, said Paul Lundstrom, Dryden's E-2C lead test engineer. To complete this task, Loads Laboratory researchers will use a data-recovery system connected to instrumentation on the airplane.

"We read and record what those instruments are telling us," Lundstrom said. "That data is used to develop what we call loads equations. This is similar to what we did with AAW (the Active Aeroelastic Wing testbed). We give (Navy technicians) loads equations that can be used to estimate loads while they're flying the airplane. This allows them to know when they're approaching loads that are too high for the structural capacity of the aircraft. It helps them define the flight envelope. You can only turn so fast at so many (g-forces). You can only dive so hard. You can only fly this turn at this altitude at this airspeed. It has to do with defining the performance parameters of the aircraft while maintaining a safe structure."

The E-2C research isn't the biggest project completed in the Loads Laboratory, but it is among the largest ever undertaken and could lead to similar work in the future, he added.

An unmodified E-2C weighs about 39,561 pounds. The Hawkeye at Dryden will have its weight beefed up with metal plates to simulate 42,061 pounds – mimicking the latest weight configuration of the upgraded Hawkeye, which also is known as the E-2C+, or Hummer. Loads will be applied to the aircraft's wings and tail.

The testbed has an 80-foot wingspan and is about 58 feet long and 18 feet tall. The Loads Laboratory can accommodate the aircraft with room to spare for equipment and fixtures necessary for conducting the research.

In preparation for the aircraft's arrival, a team of Dryden researchers met several times to discuss the schedule and scope of work to be performed. Step-by-step procedures are being developed for each project task, and responsible parties identified for each.

Dryden personnel will install and monitor the 224 strain gauges, which measure stress on the aircraft's surface, and 15 string pots, which essentially are electronic measuring tapes. Six load cells will measure aircraft reactions at fixed points on the ground. An additional 24 load cells (instrumentation that records how large a force is being applied to an area) are used for loading the wings and eight for the tail.

Lundstrom said the biggest challenge for the Dryden team is adhering to a schedule he described as tight, for a test of this size and scale.

"Our task is to find a way to get everything finished in time to support the Navy's completion date," he said.

Dryden researchers will see benefits from this project, he added.

"Every airplane you test, I think you learn something from it, because every airplane is different," he said. "In this case, one thing we'll learn is how to push on an airplane that has a very thin skin on the wings."

This work also could represent new opportunities for Dryden.

"It represents a new line of business that we hope to cultivate," he said.

The E-2A Hawkeye first entered service in 1961, was updated in 1969 as the E-2B and the E-2C was introduced in 1973. The Hawkeye engages in missions similar to those of the Air Force E-3 Airborne Warning and Control System aircraft, also known as AWACS.

The Navy's Hawkeye, which was built by Northrop Grumman, has extensive communication and long-range surveillance radar capabilities. It is considered the "quarterback" – or manager – of carrier-group operations, and boasts the ability to monitor six million cubic miles of airspace and more than 150,000 square miles of ocean surface while detecting hundreds of ships, aircraft, missiles, or targets up to 200 miles away.

Drill ... from page 2

manager for building 1623, because of what they teach participants about the unexpected. Among the most important aspects of regular safety drills are the opportunity they provide for becoming familiar with equipment, as employees learned last summer during hydrazine drills.

"Our guys had new boots (with their hazardous materials suits)," she said. "In the first drill, they found out they were having trouble getting into the boots. So we know now that we need to have some powder on hand that makes it easier to get the boots on.

"In the second drill, we shaved eight seconds off our response time. Little things like that really make a huge difference."

Dryden safety officers continuously stress that it's up to the individual to "own" his or her commitment to safety.

"In a disaster, everybody's got to do something," said Ralph Anton, Code S Environmental Safety Specialist. "You can either be a 'leader' – a fire warden, or another volunteer – or you can be a 'follower' and know what you're supposed to do.

"Either way, everybody has to take some responsibility for being safe."

Regardless of the type of emergency event, Dryden procedures to be followed are essentially the same, Anton said. Employees need to know how to evacuate buildings quickly and quietly, or to comply with a "Shelter-In-Place" order if safety officials determine that staying indoors is the safer course. All personnel should know the location of designated assembly points once they have evacuated the building.

"There's a *reason* to be at an assembly point," he stressed. It's at those locations where wardens account for all staff and then report that information back to safety officials.

Following the assembly point head count, employees should proceed to "zone boxes" if directed by wardens or safety staff. Clearly labeled zone boxes containing first aid and other emergency supplies are maintained around the campus and will be opened for use by authorized personnel if necessary.

Individual employee awareness in a disaster can go a long way toward preventing further damage or injury. Even those who haven't been trained as volunteers can help out by assisting wardens when asked or by helping keep an eye on facility functions, reporting to safety officials any equipment observed to be malfunctioning or any other potential hazards.

All these procedures can be mastered by participating in periodic safety drills. Grumbling and non-participation are inevitable, Anton acknowledged, but safety officials continue their efforts to make employees aware of the importance of knowing what to do in an emergency.

And knowing what to do just might help you and a whole lot of other people one day – like maybe the next time you and your date opt to take in a movie.

The X-Press

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Editor: Jay Levine, AS&M, ext. 3459

Assistant Editor: Sarah Merlin, AS&M, ext. 2128

Managing Editor: Michael Gorn, NASA

Address: P.O. Box 273, Building 4839
Edwards, Calif. 93523-0273
Phone: (661) 276-3449
FAX: (661) 276-3566

Dryden Home Page: http://www.dfrc.nasa.gov/

National Aeronautics and Space Administration

Dryden Flight Research Center
P.O. Box 273
Edwards, CA 93523-0273

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